

NASA SP-7047

(NASA-SP-7047) NASA PUBLICATIONS GUIDE  
(National Aeronautics and Space  
Administration) 16 p HC A02

N83-32671

CSCL 05B

00/82

Unclass  
36467

# NASA Publications Guide

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION



# NASA Publications Guide



Scientific and Technical Information Branch 1982

National Aeronautics and Space Administration

1200 Jefferson Davis Highway, Arlington, VA 22204-4302 Washington, DC 20546-0001



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# INTRODUCTION

The determined efforts of men and women working together to achieve difficult even seemingly impossible goals have built NASA's worldwide reputation for scientific research and technical accomplishment. NASA publications chronicle these efforts and illustrate the multidisciplinary requirements of space exploration. To simplify the process of producing top-quality publications, NASA has developed guidelines for authors and publications specialists. This booklet is an attempt to capture the most important on paper.

The subject matter for this booklet falls naturally into two areas. Section I describes the NASA publication

program and management policies. Section II highlights the details authors and publications specialists need to know to carry out NASA's mission of disseminating the scientific and technical information derived from its activities. Appendix A, "Guide for Determining NASA Publication Series," is included to give an idea of the appropriate report series for a NASA publication. Appendix B, "Selected Bibliography," lists the documents cited and some others discussing topics merely mentioned in this guide. Finally, the format shown here can be used as a guide for technical publications as report preparation equipment is updated.



## GENERAL INFORMATION AND REQUIREMENTS

### NASA Formal Publication Series

NASA has six types of publications in its formal report series. Each of the six categories is based on best fitting the content of an author's manuscript to the needs of an identifiable readership.

The decision as to which of the six categories to use for a manuscript is made by the technical review committee acting with advice from the Center publications office. Final approval for publication is given by the Headquarters Scientific and Technical Information Branch (STIB).

Whichever category is chosen, the publication is assigned a sequential number by STIB, and the number is prefixed by a two-letter abbreviation representing its series.

The categories are:

Special Publication	SP
Conference Publication	CP
Reference Publication	RP
Technical Paper	TP
Technical Memorandum	TM
Contractor Report	CR

### Special Publications

Special Publications record scientific and technical information from NASA programs, projects, and missions for presentation to readers of diverse technical backgrounds. NASA Special Publications often are concerned with subjects that also have substantial external interest. This series includes:

- (1) Scientific summaries of mission results
- (2) Scientific photographic atlases
- (3) Histories and chronologies
- (4) Comprehensive program descriptions and retrospective assessments
- (5) Continuing bibliographies

Because the costs involved in producing Special Publications are generally greater and the distribution of these publications wider than for other publication categories, NASA Headquarters exercises a correspondingly greater degree of control over them. Normally, titles selected for publication in this series are approved by STIB with the advice of the appropriate Program Offices or Center Publications Officers.

### Conference Publications

Conference Publications normally are compilations of scientific and technical papers or transcripts from

conferences, symposia, workshops, special lecture series, seminars, and other professional meetings. Some Conference Publications are preprinted to be distributed to conference participants; still others may be "landmark" CPs and as such may warrant extensive editorial treatment, custom handling through production and arrangement for wide availability through the U.S. Government Printing Office (GPO). For these, the originating NASA center should contact STIB for early planning.

### Reference Publications

Reference Publications are compilations of scientific and technical data and information deemed to be of continuing reference value. This series includes:

- (1) Technical handbooks and manuals
- (2) Critical tables
- (3) Monographs, including those on design criteria
- (4) Scientific and technical textbooks
- (5) State-of-the-art summaries, including critical reviews of a body of scientific or technical literature
- (6) Technical reports that provide complete and comprehensive treatment of significant contributions to scientific and technical knowledge

### Technical Papers

Technical Papers record the significant findings resulting from NASA scientific and technical programs. Technical Papers are the NASA counterpart to peer-reviewed journal articles and are subject to professional review controlled by the originating Headquarters or Center office. For documentation purposes, Technical Papers are preferred to professional journal articles because Technical Papers have less stringent limitations on manuscript length and extent of graphic presentation.

### Technical Memorandums

Technical Memorandums record scientific and technical findings that do not warrant or cannot be given broad dissemination because of the preliminary nature of the material, limited interest, or security considerations. Technical Memorandums are either formally printed and given minimal category distribution, or reproduced in a limited number (about 250 copies) and distributed by the originating office. This series includes.

- (1) Preliminary data reports—reports giving interim information of on-going research

(2) Working papers—papers prepared for the information of peers beyond the basic work group

(3) Individual seminar or symposium presentations—individual papers preprinted for distribution at a symposium

(4) Theses and dissertations—treatises written by NASA employees that relate to their work and that NASA elects to publish

(5) Bibliographies—listings of scientific or technical literature, with or without evaluation, generally in defined subject areas

(6) Sponsored reports—reports by NASA authors of work sponsored by other agencies

(7) Security-classified reports—scientific or technical reports or papers containing classified information

(8) Translations—English-language translations of foreign-language scientific and technical material pertinent to NASA work

### **Contractor Reports**

Contractor Reports record scientific and technical findings generated by a contractor's or grantee's NASA-sponsored research and development and related efforts that NASA considers worthy of publication.

Low-numbered subseries Contractor Reports are those reporting the findings of significant work conducted under NASA contracts or grants. Considered analogous to Technical Papers, these are produced and disseminated in the manner of Technical Papers.

High-numbered subseries Contractor Reports are those publications that, although presenting new technical information, do not warrant broad dissemination. These are produced in a limited number for the use of the sponsoring office.

## **Selection of Publication Medium**

### **NASA Publication**

A NASA author's decision concerning NASA publication series is subject to review as part of the Center review process. Manuscripts are assigned to a series by the guidelines listed in appendix A.

### **Oral Presentation**

Oral presentation of scientific and technical findings is one way to ensure the timely dissemination of information to an appropriate audience such as at society meetings and other professional gatherings. NASA authors who take this approach should use the Technical Memorandum as a way of distributing copies of the presentation to attendees and including their work in NASA's scientific and technical information system.

### **Non-NASA Publication**

All significant scientific and technical findings derived from NASA activities, including those generated by NASA-sponsored research and development and related efforts, should be disseminated either in the appropriate NASA publication series or in a suitable non-NASA scientific and technical medium (e.g., professional society journals, transactions, and similar periodicals, or the proceedings of conferences, symposia, and workshops). Manuscripts submitted to a journal must have NASA approval.

The use of a foreign publication medium is subject to additional restrictions beyond those applied to other publication media. To ensure that a manuscript may be submitted for publication in a foreign-based medium, authors must submit an advance copy of their proposed document to the individual designated by the Center Director to coordinate review and release of publications in foreign media. (See NMI 2220.2B.)

Regardless of the medium chosen, NASA personnel, contractors, and grantees must see that copies of each document are provided to the NASA Scientific and Technical Information Facility for inclusion in NASA's scientific and technical information system. Authors desiring additional information concerning the services of the Facility should ask their Center publications staff or write to

NASA Scientific and Technical Information Facility  
P.O. Box 8757  
Baltimore/Washington International Airport,  
Maryland 21240

### **Duplicate Publication**

The release of scientific and technical information through non-NASA media does not preclude the publication of equivalent information by NASA. For example, significant findings could be reported initially in a prominent journal (in which space limitations might constrain complete presentation of text and figures); more detailed documentation of these findings could then be made in an appropriate NASA technical publication. Although authors are encouraged to publish in journals and to make oral presentations to professional societies, the emphasis remains on the use of NASA reports whenever possible. To avoid duplication, authors should not publish NASA material verbatim in different media, with the following exceptions:

(1) Preprints of presentations made at professional meetings that may or may not appear in subsequently published proceedings or transactions

(2) Preprints of journal articles

## Non-NASA Authors

NASA generally requires contractors and grantees to submit a final report of their work. They should furnish NASA with a review copy containing appropriate acknowledgment of NASA support and identification of the contract or grant involved. These reports are generally published in the Contractor Report Series, but depending on content, may be published in another series at the discretion of STIB and the sponsoring office.

When a scientific or technical paper is to be published externally and the paper results from a classified contract or grant or when classified results are anticipated, NASA requires prior approval. Externally published reports may be entered in the scientific and technical information system as high-numbered Contractor Reports.

## Printing and Distribution

### Printing

To support its publishing program, NASA maintains a centralized printing operation at Langley Research Center. In addition, NASA uses the services of the Government Printing Office and its regional units. The reproduction of Conference Publications, limited-interest Technical Memorandums, and high-number Contractor Reports may be performed at the Centers if the subject does not warrant standard distribution. Copies of documents so produced must be provided to the Scientific and Technical Information Facility. In addition, copies of all Center-printed Conference Publications must be sent to each NASA library and to STIB.

### Microphotography

All documents entering the NASA scientific and technical information system are microfiched or microfilmed. NASA makes extensive use of microphotography as a fast, economical, and efficient way to supply information to researchers worldwide. About 80 percent of NASA scientific and technical documents are available only on microfiche; but the usefulness of the technique, which employs a reduction ratio of 24:1, is wholly dependent on the quality of the material photographed. To produce usable microfiche, the following must be avoided in camera-ready copy:

- (1) Typefaces smaller than 10 points (including computer printouts)
- (2) Color photographs, illustrations, and graphs

## Distribution

NASA uses several channels to distribute its formal series publications to the scientific and technical community. The primary method involves distribution of printed copies or microfiche to organizations that have registered their needs in 11 broad subject categories:

- (1) Aeronautics
- (2) Astronautics
- (3) Chemistry and materials
- (4) Engineering
- (5) Geosciences
- (6) Life sciences
- (7) Mathematical and computer sciences
- (8) Physics
- (9) Social sciences
- (10) Space sciences
- (11) General

Printed or blowback copies are also furnished on demand to registered requestors.

Unclassified, unlimited distribution publications are sold to the general public through the National Technical Information Service of the Department of Commerce or through the Superintendent of Documents at the Government Printing Office.

To extend the audience reached by NASA publications through the subject category system supplemental distribution may be made. Lists for supplemental distribution can be developed from requests for prior papers, known authors in the field, conference registrants, and members of organizations or groups known to have an interest in the field, as well as from lists obtained from contractors and other agencies. Each Center should maintain such lists for various disciplines and supply them, when appropriate, to STIB with the request for a print order.

NASA publications prepared for limited readership may be printed at NASA Centers and typically receive no subject category distribution. It is intended that Centers print only those reports that are intended for minimal distribution, of the order of 250 copies. Reports printed in greater numbers must be approved through regular channels and by STIB.

## Other Publication Requirements

### Acknowledgment of Contributors

**Authors.** With the exception of authors of NASA histories, the authorship of NASA publications is generally reserved for persons who participate in the performance of the work from which the scientific and technical information results (NMI 2220.5) and who can effectively defend the main technical content of the publica-

tion to a peer group. Because of the complexity of scientific and technical work, many publications have multiple authors. The authors' names should appear in a sequence that indicates their respective responsibility for the reported results; that is, the first author is the chief contributor and writer, and other authors follow in the order of the importance of their contributions to the work. However, NASA employees may not be listed as coauthors of Contractor Reports. When NASA employees contribute to, rather than merely monitor contract or grant work, such work should be published in another series.

**Sources.** Credit statements should be included for material from non-NASA publications appearing in a NASA report. In the case of copyrighted source material, authors are responsible for securing permission to reprint from the copyright holder and for including copyright acknowledgment in the manuscript.

**Sponsors.** When NASA undertakes work for another agency, NASA authors should report the scientific and technical findings in the Technical Memorandum series. Appropriate indication of sponsorship should be given on the cover, title page, and the standard report documentation page. Such publication will not, of course, preclude the sponsoring agency from publishing the work in its own series. The above instruction does not, however, apply to NASA's contractors and grantees. Contractors and grantees should not print and distribute their own series of reports on research sponsored by NASA. Rather, such reports should be published in NASA's Contractor Report series.

When NASA is the sponsoring agency, contractor and grantee authors should ensure that all publications deriving from NASA-sponsored research and development and related efforts have an indication of such support clearly displayed. In the case of journal articles, the preferred indication is a first-page footnote acknowledging NASA support and providing the contract or grant number under which the work was performed.

**References.** Authors of NASA publications should document references sufficiently well that the user will be able to identify and locate the reference. Proper references are the author's responsibility.

**Editors.** Recognition of editorship on the title page is justified only in those cases in which the editor uses scientific and technical expertise and judgment. However, merely managing a collection of papers through the production and printing process and performing associated administrative tasks does not warrant such recognition.

**Other contributors.** Contributions by individuals other than the authors to the scientific and technical content of a report deserve to be acknowledged. These would in-

clude voluntary scientific or technical help received from outside NASA. However, normal assistance furnished by NASA personnel, including professional help from groups or individuals not directly related to the research, is usually not acknowledged. Also excluded from acknowledgment are supervisors or technical committees whose comments and advice result from regular work assignments. Editing and production of the report do not constitute scientific and technical assistance. When an acknowledgment is warranted, it should be included in the last paragraph of the preface or introduction, not in a separate acknowledgments section. Acknowledgments are factual, not flowery.

**Contract and grant monitors.** Contract and grant monitors shall not be listed as coauthors of Contractor Reports. Contractor-originated NASA publications should, of course, include the name and organizational affiliation of the NASA monitor or project manager on the standard report documentation page in the "Supplementary Notes" block. Although the principal purpose is to provide a NASA contact for an interested reader who desires further information, such a note also credits the monitor or project manager for his or her role in publishing the report. In a contractor-originated Special Publication or Reference Publication, the names of the NASA project manager and sponsoring division and the contract number may be given in the preface to the report.

**Conference sponsors and editors.** Conference sponsorship is indicated on the title page of any proceedings published by NASA. When NASA shares sponsorship with other organizations, the logo of the cosponsor may appear on the cover with the NASA logo. The editors of the proceedings and their affiliations appear on the title page. Such a listing of editors is appropriate only when the editors have exercised their scientific and technical expertise in the editorial process.

## Standards

Style and format standards for NASA scientific and technical publications are provided in several sources. If conflicting guidance is encountered, the sequence of the following list shall govern:

- (1) Instructions from the Scientific and Technical Information Branch
- (2) Instructions issued by NASA Centers implementing Scientific and Technical Information Branch requirements
- (3) This publication
- (4) Government Printing Office *Style Manual*
- (5) *NASA Graphics Standards Manual*, NHB 1430.2

### **International System of Units**

The use of the International System of Units (SI) is required as stated in NMI 2220.4 for material reported in NASA scientific and technical publications. Appendix B contains references giving guidelines for the use of SI units.

### **Covers**

Except for the Special Publication series, the covers of NASA formal series publications have standard formats. Special Publication covers are designed by or subject to the approval of STIB.

Covers are usually paper rather than cloth. In some cases, such as books expected to get heavy reference use, STIB may designate case binding.

### **Color**

The use of color increases publishing costs and delays the publication date. Moreover, color illustrations cannot be microfiched. Color should be used only when necessary to convey scientific and technical material in a clear and unambiguous fashion. Approval for the use of color must be obtained by submitting justification to STIB.

### **Foldouts**

Deviations from the standard page size of a publication (such as foldouts or separate folded figures to be

placed in envelopes) are not accepted unless they significantly enhance a report. Their use requires prior approval by STIB.

### **Copyright Transfers**

Copyrights covering materials derived from an author's official duties as a U.S. government employee cannot be transferred by the employee; no U.S. copyright protection exists under these conditions. When submitting material for external publication, authors must consult NASA counsel concerning any agreements publishers wish them to sign.

Some copyright transfer forms include a signature block to be used by U.S. government authors only. It certifies that the manuscript was prepared as part of that author's official duties. There is no objection to the signing of such a certification by a government employee. Where no appropriate block is included on the transfer form for a U.S. government work, a statement such as the following should be included either on the form or in a covering letter:

The work entitled \_\_\_\_\_ (give title) \_\_\_\_\_ was prepared as part of my official duties as an employee of the U.S. government and, in accordance with 17 USC 105, is not available for copyright in the United States.



## EDITORIAL AND PAGE MAKEUP CONSIDERATIONS

### Sections of a Report

Many formal reports of scientific research have the following organizational structure:

- Front matter
- Introduction
- Main text (may contain heads such as "Procedure," "Discussion," "Tests," and "Results")
- Concluding section (may contain heads such as "Summary of Results," "Conclusions," or "Concluding Remarks")
- Appendixes (one appendix may be a list of symbols)
- References
- Report documentation page (includes abstract)

#### Front Matter

The exact elements that constitute the front matter will vary. For example, short documents may not need a contents page; longer documents probably do. Special Publications and Reference Publications may contain either a foreword (by someone other than the authors), a preface (by the author), or both. Acknowledgments for scientific contribution to the report should be included as the last paragraph in the preface or introduction.

Front matter pages carry lowercase roman numerals; the main text pages are numbered sequentially throughout with arabic numerals. Even though a page may be blank or have a special layout without a page number, it is assigned a page number.

#### Disclaimers

The use of disclaimers and similar notices is to be avoided. However, a notice may be employed to alert the reader that a particular publication:

- (1) Is a presentation of preliminary findings, subject to revision as analysis proceeds
- (2) Is a formal draft or working paper, intended to solicit comments and ideas from a technical peer group
- (3) Is a preprint of a paper to be presented at a professional meeting
- (4) Uses a trade name for descriptive purposes and does not intend endorsement (trade names may not be used when a generic term is available)

The following is an example of a statement that may appear on the back of the title page:

This is a preprint of a paper intended for presentation at a conference. Because changes may be made before formal publication, this preprint is made available with the understanding that it will not be cited or reproduced without the permission of the author.

Disclaimers calling attention to nonedited material or nonresponsibility of the issuing Center are to be avoided.

#### Introduction

The primary function of the introduction is to define the subject, significance, purpose, and scope of the work. The introduction should also include background information. Introductions will vary to some extent, depending on the nature of the material in the book or document.

#### Main Text

The central theme of a technical paper or report is developed in the main text. The overall organization of a report will vary according to the subject matter. For example, experimental investigations contain comprehensive descriptions of specimens, apparatus, and procedures. Theoretical investigations, on the other hand, emphasize the author's application of new information to the state of the art.

#### Concluding Section

Most formal NASA publications have a concluding section. This section should be self-contained because many readers will read it to determine whether to read the entire document. No material that has not already been presented in another section of the paper should be presented in this section.

#### Appendixes

Appendixes present supplementary information that might otherwise interfere with an orderly presentation of the text. Each appendix must be referred to in the text and must have a title. When more than one appendix is used, each is identified by a capital letter in the order mentioned in the report. Appendixes may be written by other authors; when this is the case, they may be credited on the title page.

#### References and Bibliography

Documents referred to in a formal NASA publication should be included in a reference list. The style and format of the reference list may follow accepted practice in the discipline of the report. When there is no preferred style, the name/date style of citation in text (Anders, 1971, 1972; Smith, 1974) is preferred because it allows manuscript revision without seeking and changing all reference numbers in text, tables, and figures. In the

reference list, the names are alphabetized. Multiple publications by the same author(s) are listed in chronological order from oldest to most recent. Documents by the same author in the same year are cited by author, year, and letter (for example, Robinson, 1970a, 1970b). Documents having no personal author may be cited in text by use of an abbreviated title.

The reference section of a formal report should list only the documents the author has actually seen or knows to be generally available. Personal communications and papers "to be published" do not fulfill these requirements and may not be included. They may, however, be acknowledged with a parenthetical note in text. The author's name, date, company and its location, and the status of the information should be included (for example, Jones, J.C., 1980, Smith Co., Washington, D.C., personal communication; Jones, J.C., 1979, *J. Phys. Chem.*, to be published).

Documents of higher classification than the report may be cited in the reference list both as an acknowledgment of the contributions of others and as a courtesy to those with access to these documents.

The following information should be given for each work in a reference list or bibliography: Author's name, exactly as given on document; exact title of document in the language of origin, with careful attention to accent marks and punctuation; the source (including identifying numbers); and the date. A translation of a foreign title may be added in parentheses. Title and subtitle should be listed exactly as they appear, although punctuation may be added as necessary. The citation for a book should give the volume, edition, publisher (and place of publication if the publisher is not well known), date, and page numbers if applicable. The citation for a periodical should give the name of the periodical and complete source information such as volume, number, month, year, and inclusive pages. If a publication is referred to several times in a paper and all the citations are not to the same part of the publication, the page numbers are preferably given at the time of mention.

When a paper is a definitive treatment of a topic, the reference section may be followed by a bibliography that has been arranged in alphabetical or chronological order or in groups by subject matter.

### Report Documentation Page

The last left-hand page inside the back cover of all publications except those in the Special Publication series contains the report documentation page. Detailed directions for preparing this page are given on the back of the form. In addition to these instructions it is useful for information retrieval to include an RTOP number in item 6 of the form.

### Abstract

Abstracts appear on the report documentation page and should be a maximum of 200 words in length and reflect clearly, concisely, and completely the subject of the report. Whenever possible, the abstract should be informative rather than descriptive and should state the objectives of the investigation, the methods employed, the results obtained, and the conclusions reached. An abstract of a classified report must be unclassified. An abstract must be able to stand independent of the text. Therefore, undefined symbols and acronyms and citations to figures, tables, and references should not appear.

### Tables

After data have been acquired, a decision must be made as to which data are to be presented in tabular and which in graphic form. If the reader needs detailed numerical data, then tables are necessary; however, if the reader just needs trends, graphs would be more valuable. If the volume of data is extensive and some readers will require numerical data, the tables may be placed in an appendix, leaving the text to carry a discussion of the data and summary graphs.

Preparation of useful tables requires careful attention to detail. Each table should have a unique title. Similar data should be presented in the same form throughout a document. The table should be arranged so that the variables are in the columns topped by boxheads (followed by a comma and the unit of measure) and the constants are given in the first column, or stub. The entries in the stub column should be given in the order that will be most helpful to the reader. Tables should be structurally uniform; if boxheads change in the middle of a table, the table should probably be divided into two tables.

Although there are occasions when text (without statistics) may be put in tabular format for the convenience of the reader, in general, tables should consist of data. Descriptive information should be in footnotes to the table rather than in the data columns. Footnotes to tables are indicated by superscript letters and generally contain information concerning special conditions relating to an entry or a class of entries.

### Figures

Figures may consist of photographs, illustrations, diagrams, and graphs. They should appear as close to their initial reference in the text as is practicable, given size and layout considerations.

Photographs of similar subjects should be sized for compatibility. Prints that already have been screened are not to be used. Photographs may be cropped for purposes of emphasis or better composition.

The author can facilitate page makeup by following certain procedures during the early stages of production. When illustrations and graphs are being prepared, as little type as possible should be inserted directly on the figure. Equations should be placed in the text; tabular material should have a separate table number; explanations should be added to captions or placed in the text. Illustrations and graphs should be prepared oversize at the same percentage so that after reduction for printing there is uniformity in the type size throughout a document.

For easy comparison by the reader, similar data should be presented in the same type of graph drawn on the same scale throughout a document. Graph lines should be as simple as possible. It is usually best to have no more than six types of lines and data points on a graph—four is better. The lines and data point symbols should refer to the same condition in related figures.

## Editorial Responsibilities

### Title

The title of a document should convey maximum information in as succinct a manner as possible. Because much indexing and abstracting is based on only the title, careful word selection is very important.

### Headings

Headings are to be brief and descriptive. They should not contain verbs and only rarely (when there is extensive cross-referencing) should they be numbered. Sections should not be “divided” into just one subsection—when this occurs in a manuscript, another subhead should be added or the existing one deleted. Good headings aid the reader in locating pertinent information quickly. Three levels of heads should be sufficient for most manuscripts; more may disrupt the concentration of the reader. When bold and italic type are not available, level 3 heads may be distinguished from level 2 heads by indentation.

### Cross-References

Cross-references in text, figures, tables, symbols list, glossary, appendixes, index, and contents must be checked meticulously each time a manuscript is revised. Inattention to these details causes errors and may reduce the confidence of the reader in the conclusions of the author.

### Grammar, English Usage, and Spelling

Manuscripts should be edited for clarity and ambiguous or awkward sentences should be rewritten. Many

useful books on English usage are available to writers and editors. In addition, the Government Printing Office *Style Manual* is a guide for punctuation, compounding, and capitalization. The GPO *Style Manual* and the *NASA Thesaurus* are guides for spelling. The *National Geographic Atlas of the World* is the reference for spelling of place names.

### Trade Names

Use of trade names is discouraged because NASA considers it improper to advertise, endorse, or criticize commercial products in its publications. Generic names should be used whenever possible. When a trade name must be used, its first appearance in text must be accompanied by the name of its registered owner.

### Spacecraft Designations

Manned spacecraft are always designated with arabic numerals before and after launch (e.g., Apollo 17). Unmanned spacecraft are designated with capital letters before launch and arabic numerals after launch. Rockets and launch vehicles are designated by name and roman numeral, including stages of multicomponent vehicles (e.g., Saturn V, S-IVB stage, and Titan III).

### Abbreviations

NASA style is to abbreviate units of measure after numbers. When abbreviations are used, they follow SI standards. If U.S. customary units are used the abbreviations of the Government Printing Office *Style Manual* are used. Singular and plural units carry the same abbreviation. Other abbreviations and acronyms may be introduced in parentheses after the complete term has been introduced and used to avoid repetition and to conserve space.

In reference lists, abbreviations are used for source material cited after the title. Periodicals and meeting titles are abbreviated according to American Chemical Society style.

### Numerals

To facilitate reading numbers of four or more digits, the digits should be grouped in threes from the decimal point, separated by thin spaces instead of commas. In the case of four digits, a space is added in columns also containing numbers of five or more digits, otherwise, four-digit numbers are closed up.

### Mathematical Presentation

The use of symbols in NASA scientific and technical publications should follow the standards established by

the particular discipline. Symbols are to be defined at the time of their first appearance in a document. If there are many symbols, an alphabetical symbols list should be developed and inserted as an appendix.

Numbers and letter symbols in expressions and equations are to be set closed up, but there is to be a space before and after mathematical functions (such as sin and lim) and mathematical signs of operation (such as +, -, and  $\times$ ); before differentials  $d$  and  $\partial$  and after their arguments; and after the arguments of trigonometric and logarithmic terms.

Equations are numbered (1), (2), (3), etc., throughout a document. Identifiers such as (1a) and (1b) may be used for equivalent or derivative equations. A brace should be used to connect a group of equations with the same number. Equations in appendixes should be numbered either in consecutive order following the equations in the text or as equations (A1), (A2), (B1), (B2), etc. The numbers for equations are usually set flush right on the same line as the equation, with space between the equation and the number. If space is insufficient to allow the number to be placed after a centered equation, the equation may be set off-center. When necessary, the number may be set below the equation. The equation number should be used to refer to an equation rather than repeating the equation; however, if it is necessary to repeat a numbered equation, the original equation number should be retained. The parentheses are retained around the equation number when the equation is cited in text.

### **Proofreading**

Proofreading must be regarded as one of the most important steps in the publication cycle. Careful proof-

reading and checking must be performed at each stage of the publication cycle if the document is to be accurate and of consistent quality.

### **Page Makeup**

The standard trim for NASA formal reports is 8-1/2  $\times$  11 inches. Thus the maximum allowable image area is 7  $\times$  9 inches, excluding the folio. Camera-ready copy may be typewritten single-spaced in a single column format or, preferably, composed in a two column format. Folios should be placed on the bottom outside corner at the pages.

Figures and tables should appear as close to their initial citation in text as possible, preferably at the top or bottom of a page. They may be placed before the point of citation if necessary as long as they are on the same or the facing page. Figures and tables should never fall outside the main section in which they are mentioned; however, they may fall outside their subsection. Grouping figures and tables at the end of a document is appropriate only when such placement facilitates necessary expeditious publication or when large groups of figures or tables create reading or layout problems. Figures should be run upright rather than broadside (sidereading) whenever possible. Foldouts may usually be avoided by rearranging and spreading the figure horizontally across a two-page spread.

A column may not end with a head alone, a head and only one line of text, or a short line that is not the last line of a paragraph. A column may not begin with the last line of a paragraph. Similar elements on facing pages should be spaced roughly the same.

## GUIDE FOR DETERMINING NASA PUBLICATION SERIES

*If manuscript consists of —**the appropriate series is —*

Article for a professional journal	None required; TP for expanded treatment and TM for preprint
Article for a technical magazine	None required; TP for expanded treatment and TM for preprint
Atlas of scientific imagery	RP or SP
Bibliography:	
Continuing	SP
Extensive annotation	RP
Minimal annotation	TM
Computer program application	TM
Contractor or grantee results and findings	CR, RP, or SP
Critical review of the literature	TP or RP
Critical tables	RP
Data compilation:	
Extensive use	RP
Limited use	TM
Design standards	RP
Dissertation of thesis by employee, relating to work	TM
Engineering report	TP
Handbook	RP
History	SP
Letter (e.g., to <i>Letters</i> journal)	None required
Limited distribution report	TM
Literature survey, review	RP or TP
Manual	RP or TM
Monograph	RP
Preliminary results report	TM
Preprint of paper for a professional meeting	TM
Proceedings of a workshop, conference, seminar, etc.	CP
Program description or summary	SP
Report to another agency	TM
Research report	TP
Review paper	TP
Security-classified report	TM
Sponsored research report:	
NASA sponsor	CR
Non-NASA sponsor	TM
Standards for design	RP
State-of-the-art review	RP or TP
Technical report—complete, comprehensive	RP
Textbook, scientific or technical	RP
Translation	TM
Working paper (external circulation)	TM



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